lence" or ability to fix nitrogen. The contradictory results of other investigations are probably due to the use of different strains of organisms. The differences between these strains are varietal or, possibly, even specific, for cultures from various sources differ considerably in their nitrogen-fixing power.

BEIJERINCK in his work on these organisms proposed a theory of symbiotic activity between Azotobacter and other bacteria. KRZEMIENIEWSKI concludes that BEIJERINCK'S results are to be explained not as due to the presence of the second organism but to the addition of humus to culture solutions.

These studies should serve to emphasize further the importance of soil humus from the standpoint of agricultural practice. In addition to the solution of certain puzzling questions, KRZEMIENIEWSKI has opened several very promising avenues for successful and profitable research in soil bacteriology.—ROBERT E. BUCHANAN.

Mutability and variability.—SCHOUTEN[18] has an extensive account of two years' Oenothera cultures. Seeds from DEVRIES, as well as commercial seeds and "wild" seeds, and rosettes of various species were used. Several new mutants appeared, and a number of interesting combination forms possessing the characters of two types are recorded. The new mutants are *O. blanda* and *O. candelabriformis*, while the combination forms include *O. laevifolia brevistylis*, *O. laevifolia nanella*, *O. rubrinervis brevistylis*, *O. rubrinervis lata*, *O. gigas nanella*, and *O. gigas lata* (?).

He makes the suggestion, which appears rather unlikely, that the *nanella* or dwarf condition in *OO. Lamarckiana*, *laevifolia*, and *gigas* may be due to bacterial action. *O. Lamarckiana nanella* is found to exist in two forms, differing in their bud and flower characters. *O. gigas* is well known to show extremely wide variability, particularly in leaf shape, and an attempt was made to segregate several types, but without success, since the offspring from each showed nearly the whole range of variation.

The occurrence of a number of combination types as mutants in pure strains gives a somewhat different appearance to the mutation phenomena in Oenothera. SCHOUTEN concludes that mutants originate by two different methods: (1) When both the gamete nuclei uniting in fertilization have the constitution of the same mutant. (2) When the gamete nuclei are unlike. Of the latter he classifies two sorts. (*a*) When one gamete nucleus has the constitution of the species and the other that of the mutant. (*b*) When both the gametes have a mutant constitution but not of the same mutant, thus accounting for the combination forms. Further evidence is obtained from the fact that crossing increases the production of mutants.

The third part of the contribution deals with statistical studies of variability in *O. Lamarckiana* and its mutants, and in several wild species. The parts measured include the length and breadth of certain stem leaves selected according to a definite rule; the length and breadth of the petals and sepals of certain selected

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[18] SCHOUTEN, A. R., Mutabiliteit en variabiliteit. pp. 196. Groningen. 1908.

flowers; the number of stigma lobes; the length of style, hypanthium, and ovary; length of main stem; number of side branches, etc. A large number of interesting data of variability are here brought together. It is of interest that in nearly all cases the modal number of stigma lobes shows a decrease from 6 or 8 or more to 4 during the season.

The work is an extension of SHULL'S[19] statistical studies. SHULL found that in the characters measured, the mutants of *O. Lamarckiana* are more variable than the parent form, and hence that phylogenetically younger forms are probably more variable than the phylogenetically older. This appears to hold for the European *O. biennis* and its mutants *cruciata* and *sulfurea*, but is only partly true for *O. Lamarckiana* and its mutants. *O. gigas* and *O. rubrinervis lata* are more variable than the parent in all the organs examined; but the other mutants are more variable in some characters and less so in others. The coefficient of variability of a mutable species is not markedly different from that of a non-mutable form.—R. R. GATES.

Ontogenetic theory of alternation.—LANG[20] has outlined an interesting theory of alternation of generations which he calls an "ontogenetic" theory, to distinguish it from other theories. The so-called "homologous" and "antithetic" theories are well known, and LANG'S work on apogamy in ferns inclined him to accept the former. In fact, the ontogenetic theory is a theory of homologous alternation in its phylogenetic application.

The author starts with the idea that all the cell progeny of a germ cell are potentially similar, and that any one of them might reproduce the organism. The development of a specific organism is regarded as due to the properties of the germ cell and to the conditions under which the germ cell develops. The author, therefore, reaches the conception of a specific cell corresponding to each specific form, to which under normal conditions it gives rise. In plants with a definite alternation of generations, germ cells capable of developing into an organism are met twice in the life-history. The organisms developed by these two cells may be very similar or very different. For example, in Polysiphonia the two resulting organisms are very similar; while in bryophytes and pteridophytes they are very different. To explain the latter case the author recognizes two alternative views: (1) the two germ cells are so different that they necessarily produce different structures; (2) the two germ cells are both specific cells of the same plant, but the conditions of development are so different that the two resulting organisms are very different.

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[19] MACDOUGAL, D. T., *et al.*, Mutants and hybrids of the Oenotheras. Pub. No. 24, Carnegie Institution. pp. 57. *figs. 13. pls. 22.* 1905; Mutations, variations and relationships of the Oenotheras. Pub. No. 81, Carnegie Institution. pp. 92. *pls. 22. figs. 73.* 1907.

[20] LANG, W. H., A theory of alternation of generations in archegoniate plants based upon the ontogeny. New Phytol. **8**:1–12. 1909.